

## **NERRS Science Collaborative Progress Report for the Period 9/1/12 through 2/28/2013**

**Project Title:** Sustainable Shorelines along the Hudson River Estuary

**Principal Investigator(s):** Betsy Blair, Hudson River NERR, NYS DEC

**Project start date:** 9/15/10

**Report compiled by:** Betsy Blair

### **Contributing team members and their role in the project:**

- Emilie Hauser, NYS DEC Hudson River NERR -- outreach coordination and project coordinating committee
- Ona Ferguson, Consensus Building Institute (CBI) – project integration lead and project coordinating committee
- Stuart Findlay, Cary Institute of Ecosystem Studies -- ecological studies and project coordinating committee
- Nickitas Georgas, Stevens Institute of Technology -- physical forces assessment and project coordinating committee
- Kristin Marcell, NYS DEC Hudson River Estuary Program and Cornell University -- project coordinating committee and climate change program liaison
- Dan Miller, NYS DEC Hudson River Estuary Program -- demonstration project development, ecological studies, and project coordinating committee
- Jon Miller, Stevens Institute of Technology -- physical forces assessment, demonstration project, and project coordinating committee
- Dave Strayer, Cary Institute of Ecosystem Studies -- ecological studies and project coordinating committee
- Kathie Weathers, Cary Institute of Ecosystem Studies – project integration and project coordinating committee
- Eric Roberts, Consensus Building Institute (CBI) – facilitation support

### **A. Progress Overview:**

The purpose of the Hudson River Sustainable Shorelines Project is to provide science-based information about the best shoreline management options for preserving important natural functions of the Hudson River Estuary's shore zone, especially as sea level rise accelerates and storms increase in intensity. With the ongoing input of decision-makers and intended users of project results, the project team is generating new information about engineering performance, ecological tradeoffs, economic costs, projected river conditions, legal and regulatory opportunities, and the needs and priorities of key audiences. With NERRS Science Collaborative funding, the shorelines project team is 1) conducting studies to test how shoreline structure affects ecological services, 2) expanding knowledge of physical forces impinging on shorelines, 3) constructing a demonstration site, and 4) and developing one or more decision support tools. The project involves and fosters collaboration with shorelines decision-makers, with the ultimate goal of providing useful products, informing decisions, and influencing outcomes.

Phase 1 of the project, which was funded separately, concluded on July 31, 2012. The final work for Phase 2 is underway, with the final deadline recently extended to August 2014.

### **B. Working with Intended Users:**

On October 3, 2012, the Advisory Committee met for a full day meeting - the first joint meeting since the Advisory Committee and the Project Team were combined. We had 19 members of the Committee in attendance, plus 12 members from the Coordinating Team/planning group. The Advisory Committee members discussed final project products and the results of the cost

analysis research by the Stevens Institute coordinating team members. Advisory Committee members also received progress updates on the demonstration sites and the demonstration site network as well as the work to model the physical forces in the Hudson River. Evaluations from this meeting were very positive, with several participants expressing appreciation for the balance of discussion and presentation, and one person writing that it was: "Very well organized and thought about. Relevant and up-to-date, a good mix of review of old and new topics, discussion and brainstorming." In evaluations people also suggested other venues where our team might present project results and noted key components of upcoming work they thought the team needed to pay close attention to.

During this reporting period we have had at least seven Coordinating Team calls, and had regular project management calls among Betsy Blair, Emilie Hauser, Ona Ferguson and Eric Roberts to keep project activities on track. On Coordinating Team calls, we typically work on giving feedback on work in progress to one or more sets of researchers, as well as checking in broadly on the many moving pieces of the project. We also make plans for next steps to be sure we are keeping everything moving forward and that we are all accountable to each other. We also held one meeting of the informal shoreline and habitat adaptation dialogue (SHAD) group on December 11, 2012. Consensus Building Institute staff continued to provide expert facilitation and project management services to advance the project.

Three group members presented on the Sustainable Shorelines Project and case studies at a Northeast Chapter of International Erosion Control Association (NC IECA) conference on November 7-9, 2012. On November 15, 2012, we presented information about sustainable shorelines considerations and initial best management practices at a Revitalizing Riverfronts community forum in Peekskill, NY. The forum was the fourth in a series being organized by Scenic Hudson, the Hudson River Estuary Program, and the Research Reserve to promote community dialog on climate adaptation.

Several documents were completed and added to the project website, including case studies from the Cocksackie Boat Launch, the Harlem River Park and Hunts Point Landing, as well as case study presentations from the NC IECA conference that describe site planning, design and implementation of ecologically enhanced shorelines.

Following a tip from an Advisory Committee member at our October 3 meeting, we contacted NOAA and Army Corps of Engineers (ACOE) staff about their initiative to catalogue living shorelines in the NY/NJ area, with the intent of helping them to avoid undertaking duplicative work with that completed in this project. We've had several conference calls with the NOAA staff person, and jointly convened a webinar to brief staff at the ACOE's New York District on 01/22/2013. The briefing included a general overview, engineering options, results of the cost analysis, and the demonstration project and demonstration network.

*In the next 6 months we plan to:*

- Send a written update to the Advisory Committee in early spring.
- Plan a day-long Advisory Committee meeting for early fall.
- Hold Coordinating Team conference calls every 4-5 weeks.
- Reconvene the regulator and permit staff whom we met with early in the project and gather updated input on the most useful ways to communicate project results to that particular group of users.
- Simulate a decision making process internally of how people make shorelines decisions and how they might use our tools to identify what other products or tools we need to be developing.

- Continue to explore opportunities to contribute project recommendations to state or other programs, and to inform policies that affect shorelines, for example sharing our work with environmental remediation staff at NYS DEC.
  - Contribute work from this project to an upcoming Hudson River Estuary Restoration Planning initiative that will involve NYS DEC, NYS Department of State, ACOE and a suite of partner non-profits.
  - Incorporate information about shoreline management options into the work of the Kingston Flooding task force, which many from our project are involved in leading, the task force has met twice during this reporting period.
  - Provide one training workshop to NYS DEC Division of Environmental Remediation staff on shoreline management and our findings in the context of a 2-workshop series on adapting remediation planning to climate change.
  - Depending on funding, transfer findings to other Reserves.
- C. *Lessons Learned:* This 6-month period has been primarily devoted to getting some intensive research done on the engineering work, with less on engagement of stakeholders. We're looking forward to sharing draft findings once they're ready to be discussed, in coming months. Progress on project objectives for this reporting period:

### 1) ***Shoreline structure effects on ecological services***

Stuart Findlay and Dave Strayer (Cary Institute) and Dan Miller (DEC Hudson River Estuary Program) collected data on the physical structure and fish communities of 20 built shorelines (timber cribbing, sheet pile bulkheads, and rip-rapped revetments). The data are very noisy, but suggest that shores that are more physically complex may support more fish (especially small fish), and more diverse fish communities than physically simpler shorelines. These conclusions require further testing, and the group is now discussing whether to take additional samples at these 20 sites in 2013. The ecology group also sampled plant communities and physical attributes along 21 riprapped revetments. We are doing the final quality checks on these data sets, and expect to analyze these data in the upcoming months.

Christina Tobitsch, an intern at the Hudson River NERR, began to compile the rapid assessment results data sheets to enable Stuart Findlay to analyze the results. Stuart and Dave developed the Rapid Assessment Protocol early in 2012. It is designed to enable people without ecological expertise to evaluate the ecological components of a shoreline in an hour or two. The protocol has been tested with high school and college students including Stevens Institute students.

*In the next 6 months we plan to:*

- Analyze and write up the results from the surveys of shoreline vegetation.
- Consider taking additional samples of shoreline fish communities.
- Analyze the results of the rapid assessments of shorelines.

### 2) ***Physical forces on shorelines***

The overall goal of the engineering and modeling analysis is to characterize the physical forces acting on the shorelines of the Hudson River Estuary (HRE) using a combination of modeling and observational approaches. Jon Miller and Nickitas Georgas (Stevens Institute) are making progress on multiple fronts in the engineering realm.

#### *a. Refinement of NYHOPS model*

Nickitas Georgas has refined the New York Harbor Observing and Prediction System model to generate much more accurate information than currently exists about currents and waves in the Hudson Estuary to the Troy Dam. He completed an ultra high resolution grid with both bathymetry and potential future inundation zones, and interpolated meteorological, hydrological, and astronomical forcing functions on the grid.

**b. Analysis of ice historical record and production and distribution of ice GIS map layers**

All ice records since 2005 were analyzed and incorporated into a new Hudson River ice climatology dataset by Nickitas Georgas. Daily records included ice thickness, ice area, and ice type throughout the past winter seasons, compiled by Hudson River region. Probabilities for ice occurrence, ice thickness, and prevalent ice types were computed by region, summarized, geo-referenced, and included in a new interactive GIS layer, complete with pictures of the seasonal Hudson River ice cover, probability statistics, data cards, and extensive metadata information that includes uncertainty estimates for ice thickness. Nickitas is also coordinating with John Ladd and the NYS GIS Clearinghouse to post the ice layer there. The metadata for the layer are complete. Nickitas continued to exchange information with Hudson River pilots to aid their navigation and ability to accurately estimate and manage cargo volume and transit times.

**c. Creation and analysis of NYHOPS data and assessment of NYHOPS predictions**

The model's forcing was created and the sECOM model was run for a year to produce hydrodynamic predictions for water levels, currents, and waves along the Hudson's coastlines. The model refinement work included: generating and mapping wind and other meteorological variables on the grid's surface, hydrological inputs from the distributed network of Hudson tributaries, streams, and wastewater treatment plant outfalls on the grid's sides, and tidal and other ocean-generated forces on the grid's open boundary at the Battery. Nickitas spent considerable time running and trouble-shooting the sECOM hydrodynamic model to generate current and wave data along the Hudson River's coastline; he ultimately determined that for the moment model runs must focus on areas that are currently inundated by tides, and exclude areas of projected future inundation. The new model's predictions were assessed while the model was running. The model output time series at each of over 50,000 locations were extracted. Substantial progress was made on the statistical analysis of model results for currents, water levels, and surface wind waves, and will be completed early in the next reporting period. Nickitas began creating GIS layers displaying and quantifying the statistical analysis, and this will be completed in the next few months.

**d. Analysis of wake data and development of analytical wake model**

Data collected during the summer of 2012 was collated and analyzed, and is being put into a form for dissemination via a GIS layer. Jon Miller and students began tabulating the data at each site into discrete distribution functions which are being compared to the river-wide (Tappan Zee to Troy) distributions. Jon et al. began developing distributions for wake height, wake period, vessel type, vessel speed, vessel size, and distance from shore. In addition plots of combinations of these factors (i.e., wake height versus vessel speed) are being developed to identify relationships which may not be represented in the analytical model. Work on the analytical model continued during this period. Jon and students refined the analytical model, and finalized the discretization<sup>1</sup> of the river based on geometric characteristics.

*In the next 6 months we plan to:*

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<sup>1</sup> In mathematics, **discretization** concerns the process of transferring continuous models and equations into discrete counterparts. This process is usually carried out as a first step toward making them suitable for numerical evaluation and implementation on digital computers.

- Analyze the 2012 field data and compare them with the analytical model. Some of this work will be completed with undergraduate students supported by external funds.
- Carry out a second field measurement campaign to supplement the 2012 data.
- Work on a 2-page summary of the ice work and findings, physical implications of which have been published in the Journal of Physical Oceanography. The summary will be available at the project website at [www.hrnerr.org/udson-river-sustainable-shorelines/](http://www.hrnerr.org/udson-river-sustainable-shorelines/).
- Finalize the statistical analysis of model results for currents, water levels, and surface wind waves.
- Finalize the GIS layers displaying and quantifying the statistical analysis.
- Post GIS layers on the NYS DEC Clearinghouse website.
- Work on a 5-page summary of the physical forces work.

### 3) **Demonstration sites and demonstration network**

#### a) Quiet Cove Demonstration Site

Dan met with Dutchess County Department of Public Works (DPW) staff to review site plans for rehabilitation of the entire shoreline at Quiet Cove Park. Based on his recommendations of ways to enhance habitat value and minimize project impacts, the County made several design adjustments, including the addition of plantings and no action at locations not requiring stabilization. DPW has agreed to collaborate with Sustainable Shorelines partners in the design and fabrication of a post-installation enhancement of a section of vertical sheet pile bulkhead. This enhancement would increase habitat value by increasing structural complexity and possibly supporting vegetation. Project engineers will work with research members of the Sustainable Shorelines team on the design concept, seeking to develop one that could be replicated and installed on throughout the estuary, provided an ecological benefit can be demonstrated.

#### b. Dockside Demonstration Site

Dan Miller collected letters of support from multiple stakeholders including the property owner (New York State Parks) and the Village of Cold Spring, New York for the design of a demonstration site at the Dockside property.

#### c. Coxsackie Boat Launch Demonstration Site

Dan Miller continued to monitor vegetation and overall stability of the Coxsackie Boat Launch demonstration site.

#### d. Demonstration Site Network

Emilie Hauser and two interns advanced documentation of the demonstration network sites and creation of an on-line directory, working with the a workgroup Brian Cooke, an SCA intern, worked with the site designers and completed two case studies (Harlem River and Hunts Point) and drafted two others (Habrshaw and Esopus Meadows). Christina Tobitsch, the new SCA intern, worked on completing these drafts and began a case study of Foundry Dock, working with designers, property owners and funders.

#### *In the next 6 months we plan to:*

- Post the finished case studies to on-line directory.
- Assess 2 to 3 other potential network sites and determine whether to prepare full case studies of these.
- Notify potential users (engineers, landscape designers and regulators of the postings of new case studies.
- Develop a standard sign to post at network sites.
- Monitor the annual growth of vegetation at the Coxsackie boat launch site.

- Develop scopes of work and contracts for design work at the Quiet Cove and Dockside demonstration sites.
- Record the process and progress at Quiet Cove and Dockside.

*Lessons Learned:* It is time consuming and challenging to retrospectively develop case studies for ecologically enhanced shoreline projects; locating documentation and coordinating information provided by funders, designers and property owners and managers.

#### 4) **Decision support tool**

The coordinating team continued to discuss final products and to envision options for decision support tools. We began planning to reconvene the regulators and experts who participated in prior focus groups to update them about progress, familiarize them with existing products and tools, and seek their guidance on best ways to package and refine the large body of technical information soon available to them. Dave Strayer applied for private foundation funding to develop three decision tools.

*In the next 6 months we plan to:*

- Reconvene focus groups/meetings of regulators and experts to obtain guidance on decision support tools needs and desires.
- Develop and advance concepts for decision support tools.

#### D. Benefit to NERRS and NOAA:

NERRS Webinar: On October 23, 2012, Betsy Blair and Ona Ferguson delivered a 1.5 hour seminar to teach Reserve staff about the Sustainable Shorelines process and the products produced by the project to date. The webinar was recorded by NERRS Science Collaborative.

Webinar with NOAA and Army Corps of Engineers (ACOE), New York District: On January 22, 2013, four members of the Sustainable Shorelines Project team briefed regional NOAA and ACOE staff on several elements of the project to inform a joint NOAA/ACOE regional effort to develop a list of demonstration sites and related guidance on shorelines treatments. Our presentation included a general overview, engineering options, cost analysis and the demonstration project and networks. A report on New Jersey's regulatory efforts was also included.

Ona Ferguson worked closely with NERRS Science Collaborative staff to design and help lead a February 7, 2013 webinar for collaborative leads from Science Collaborative-funded projects about tracking lessons learned across sub-sectors and across years for multi-year projects.

#### E. Describe any activities, products, accomplishments, or obstacles not addressed in other sections of this report that you feel are important for the Science Collaborative to know

##### Events:

The surge from Superstorm Sandy travelled up the Hudson on the evening of October 28 and early morning of October 29<sup>th</sup>, causing flooding with elevations/depths that established it as the storm of record. Hard engineered shoreline was damaged. Softer shoreline restorations at the Cocksackie Boat Launch and Esopus Meadows were undamaged. The flooding provided an opportunity to increase awareness of both sea level rise and the need for ecologically enhanced shoreline protection. It also became clear that decision-makers are hungry for information about what innovative treatments exist and can work in their settings.

Other Outreach Activities:

Revitalizing Hudson Riverfronts - Westchester County, 11/15/2012: Workshop included information on sustainable shorelines and was attended by 114 local officials, business people, and community members, primarily from Westchester County.

Promoting Resilient Shorelines along the Hudson River Estuary- Fishkill, NY 11/7/2012: The findings of the Hudson River Sustainable Shorelines Project were presented during a conference of the Lower Hudson Coalition of Conservation Districts and International Erosion Control Association. The 1.5 hour session included a project overview, three case studies covered the design of ecologically enhanced engineered shorelines, and a talk about the lifecycle cost analysis. The event was attended by 15 landscape architects, engineers and erosion control experts. This event took place shortly after Superstorm Sandy. All three sites highlighted in case studies survived the storm and had been subsequently visited by the design engineers/ speakers.

Workshops for NYS DEC contaminated site remediation staff: Emilie and Betsy began planning for trainings on climate challenges for shoreline remediation and opportunities to accomplish both remediation and ecologically enhanced shorelines.